April 15, 1958 H. F. MASON 2,831,073

SWITCH STRUCTURE

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FIG. 2.

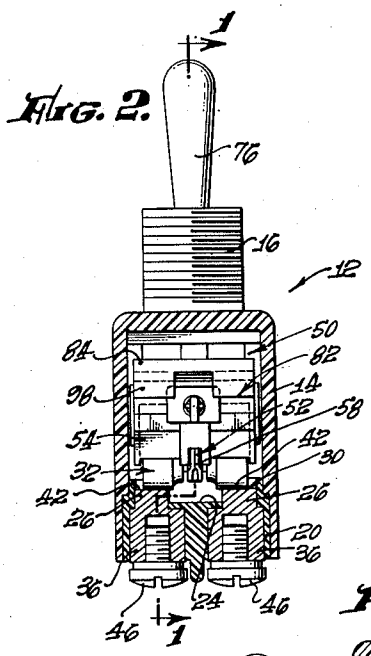


FIG. 1.

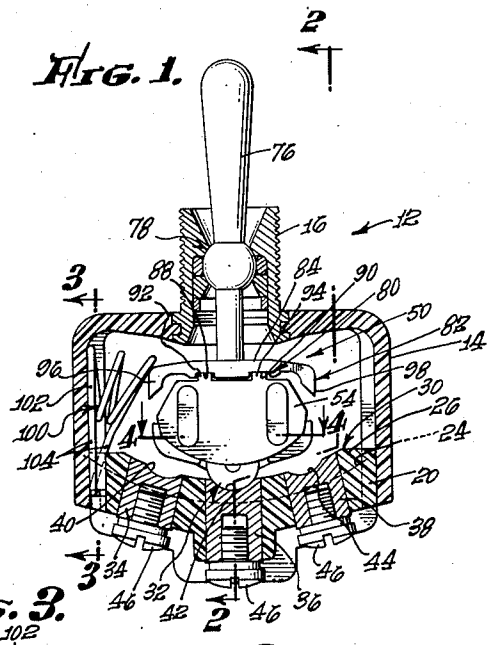


FIG. 3.

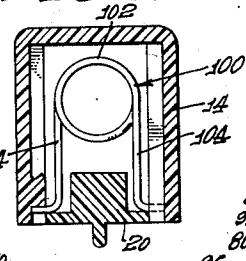


FIG. 5.

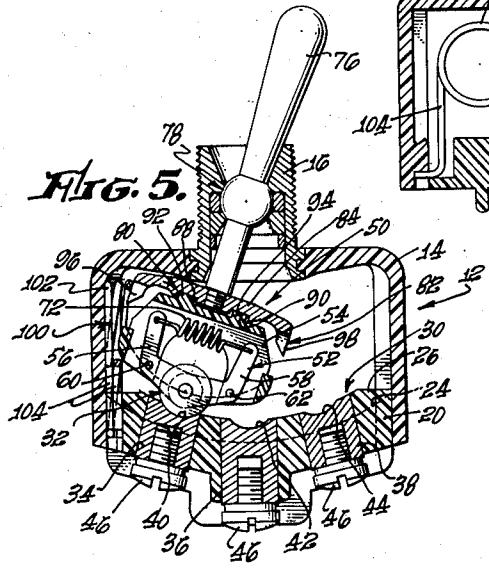
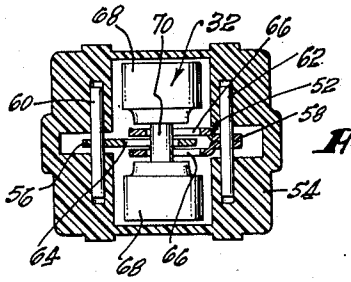


FIG. 6.

FIG. 4.



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FIG. 7.

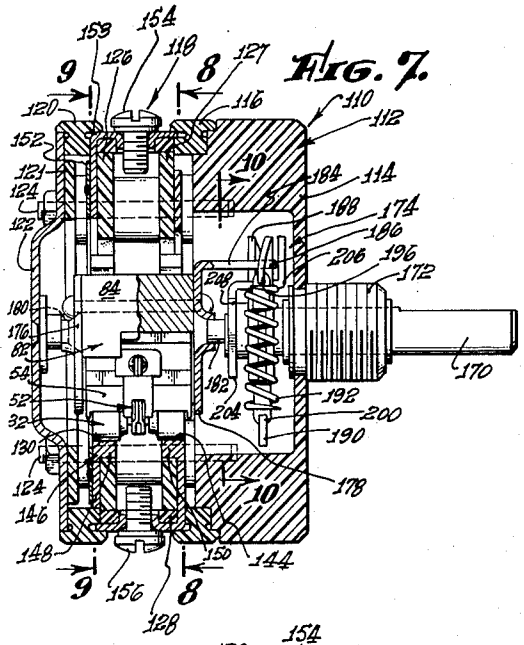


FIG. 8.

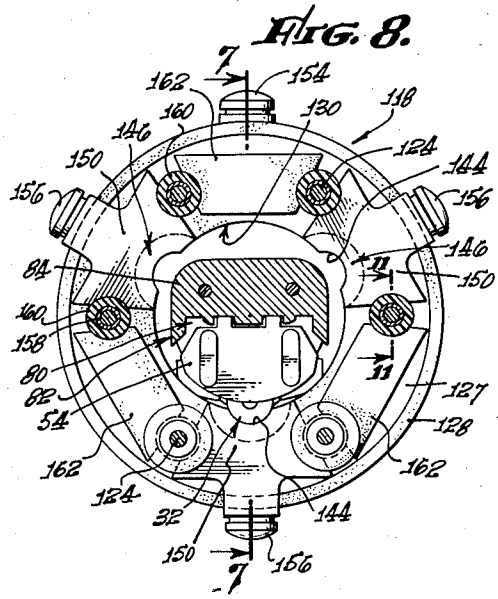


FIG. 9.

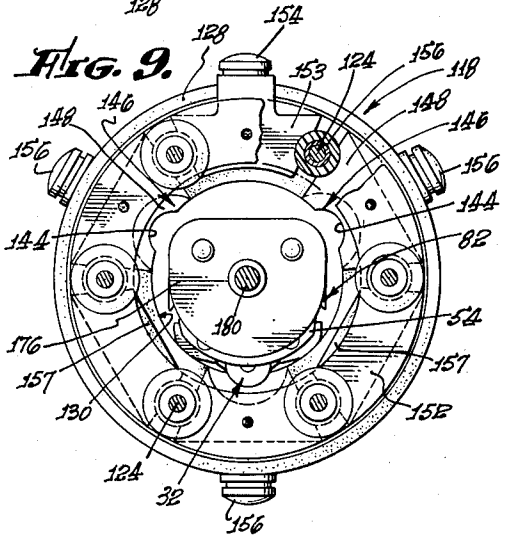


FIG. 10.

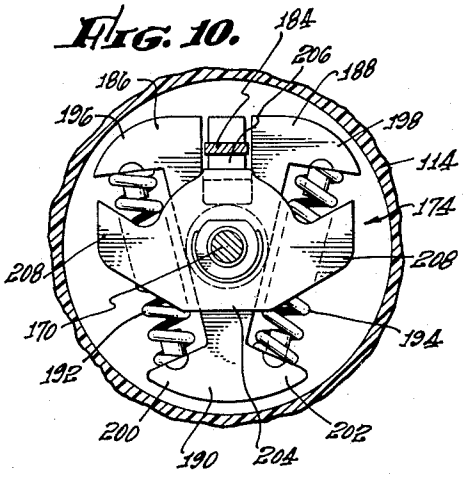
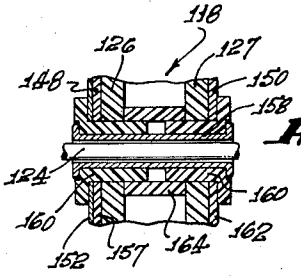


FIG. 11.



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United States Patent Office 2,831,073 Patented Apr. 15, 1958

2,831,073

SWITCH STRUCTURE

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Application June 11, 1956, Serial No. 590,422

19 Claims. (Cl. 200—6)

The present invention relates in general to electric switches, and a general object of the invention is to provide a switch which operates with a snap action to provide a fast make and break to minimize arcing, which operates in a positive manner in the sense that the movable contact snaps from one operative position to another without any possibility of pausing between the two operative positions, which operates in the foregoing manner irrespective of how the switch is manipulated manually by the operator, which provides a positive "feel" so that the operator can readily tell that the switch has advanced from one operative position to another, and so forth.

Another general object of the invention is to provide a switch which in some respects constitutes an improvement on those disclosed and claimed in my copending application Serial No. 325,401, filed December 11, 1952, and Serial No. 526,908, filed August 8, 1955, the present application being a continuation-in-part of the former. However, various features of the switch of the present invention are independent of those disclosed and claimed in my said copending applications, and it will be understood that such features are not to be regarded as limited thereto except insofar as may be required by the patent claims forming part hereof.

Considering the switch of the present invention generally, it includes a contact path having two or more recesses therein which define operative positions of a movable contact, the latter preferably being a roller contact adapted to roll along the contact path. More particularly, the invention contemplates a switch wherein the contact path is arcuate, defining either part of a circle, or a complete circle, and wherein stationary contacts are located at the recesses in the arcuate contact path, the recesses being formed in such stationary contacts. Thus, the roller contact engages stationary contacts in one or more of its operative positions wherein it is received in one of the recesses, the contact path being formed of electrically insulating material adjacent the stationary contacts. The switch of the invention also includes an actuating means for moving the roller contact along the contact path and into and out of each of the recesses therein.

With the foregoing general background, a primary object of the present invention is to provide a switch having spring-biased toggle means connected to the actuating means and the roller contact for biasing the roller contact into engagement with the contact path, such toggle means being yieldable to permit movement of the roller contact out of each of the recesses.

With the foregoing construction, the resistance to movement of the roller contact out of each recess which is provided by the resiliently yieldable toggle means results in a positive action and a positive "feel" advising the operator that the roller contact is indeed in one of the recesses. Also, the manual force necessary to displace the roller contact out of each recess in opposition to the action of the resiliently yieldable toggle

means results in movement of the roller contact from one recess to the next with a snap action, irrespective of any manual manipulation of the actuating means which the operator may attempt after the roller contact has left the first recess.

An important object of the invention is to provide a spring-biased toggle means which includes two pivoted toggle arms carrying the roller contact and which includes spring means for biasing the toggle arms in opposite directions such that the roller contact is biased into engagement with the contact path.

Another important object of the invention is to provide an actuating means which includes an actuator and a carrier for the roller contact, the spring-biased toggle means including two toggle arms pivotally mounted on the carrier and having the roller contact mounted thereon, and including spring means for biasing the toggle arms in opposite directions in such a manner as to bias the roller contact into engagement with the contact path.

A further object is to provide a spring-biased toggle means of the foregoing character wherein the two toggle arms are provided with registering slots in which the roller contact is rotatably mounted, these slots permitting toggle-like movement of the two toggle arms toward and away from each other without any change in the spacing of the pivotal connections of the toggle arms to the roller-contact carrier.

Another object is to provide a lost-motion connection between the actuator and the carrier which permits relative rocking movement between these elements, and to provide means for limiting the extent of such relative movement. the range of relative movement between the carrier and the actuator preferably approaching the spacing between the recesses in the contact path so as to provide for movement of the roller contact substantially from one recess to the next with little or no further movement of the actuator so that the roller contact snaps from one recess to the next. The lost-motion limiting means insures displacement of the roller contact out of the particular recess in which it is disposed after the range of relative rocking movement between the actuator and the carrier has been taken up, the relative-movement-limiting means comprising stop means on the actuator which engage the carrier. Such stop means thus serve as "kickers" for kicking the roller out of the particular recess in which it is located, thereby providing a positive action, which is an important feature of the invention.

An object in connection with one embodiment of the invention is to provide an actuator comprising a simple lever having an element thereon which carries the aforementioned kickers.

Another object of the invention in connection with another embodiment thereof is to provide a rotary switch wherein the actuator comprises a rotary element having the aforementioned kickers thereon, this rotary element being connected to a drive shaft by a flexible, lost-motion connection.

The foregoing objects, advantages, features and results of the present invention, together with various other objects, advantages, features and results thereof which will be apparent to those skilled in the art in the light of this disclosure, may be attained with the exemplary embodiments of the invention illustrated in the accompanying drawings and described in detail hereinafter. Referring to the drawings:

Fig. 1 is a sectional view of the switch of the invention taken in a longitudinal plane relative to the contact path of the switch and taken along the arrowed line 1—1 of Fig. 2;

Figs. 2 and 3 are sectional views respectively taken along the arrowed lines 2—2 and 3—3 of Fig. 1;

Fig. 4 is an enlarged sectional view taken along the arrowed line 4—4 of Fig. 1;

Figs. 5 and 6 are longitudinal sectional views similar to that of Fig. 1 and illustrating the operation of the switch shown in the preceding figures;

Fig. 7 is a sectional view of another embodiment of the switch of the invention taken in a plane including the axis of rotation of various components thereof and taken along the arrowed line 7—7 of Fig. 8;

Figs. 8, 9 and 10 are sectional views respectively taken along the arrowed lines 8—8, 9—9 and 10—10 of Fig. 7; and

Fig. 11 is an enlarged, fragmentary sectional view taken along the arrowed line 11—11 of Fig. 8.

Referring particularly to Figs. 1 and 2 of the drawings, the embodiment illustrated therein constitutes a toggle switch of the invention and is designated generally by the numeral 12. The switch 12 includes a case or housing 14 which is open on one side and which is provided in its opposite wall with an aperture through which projects a fitting 16, the latter being molded into the housing. The fitting 16 is externally threaded to receive a nut, or the like, not shown, for mounting the switch 12 on a panel, not shown, with the panel clamped between such nut and the housing 14 in the usual manner.

Within the housing 14 and closing the open side thereof is a block 20 of electrically insulating material, such as a suitable plastic. This block is provided with an arcuate inner surface having therein a central arcuate groove 24 separating two arcuate ribs 26. The inner surfaces of the ribs 26 form parts of an arcuate contact path 30 for a freely rotatable roller contact 32 to be described hereinafter.

Spaced apart along the contact path 30 and forming parts thereof are contacts 34, 36 and 38, the contact path 30 being provided with recesses 40, 42 and 44 for the roller contact 32 in the respective contacts 34, 36 and 38. Preferably, each of the contacts 34, 36 and 38 includes two contact elements respectively set in the ribs 26 and adapted to be bridged by the roller contact 32, each of the recesses 40, 42 and 44 being formed in both contact elements of the corresponding contact. The contact elements of the contacts 34, 36 and 38 may be electrically interconnected in various ways, or they may be electrically independent and provided with independent terminal screws 46 as shown, depending on the use to be made of the switch 12.

As shown in Fig. 2 of the drawings, the roller contact 32 engages only the contact elements of the contact 36 when the roller contact is in its intermediate position, the depth of the groove 24 in the block 20 being such as to prevent engagement between the roller contact and the block in this position of the roller contact. The same is true of the other positions of the roller contact 32. Also, it wil be noted that the recesses 40, 42 and 44 in the contacts 34, 36 and 38 are not quite as wide as the contacts themselves, in the direction of the contact path 30, so that these contacts form parts of the intermediate sections of the contact path between the recesses. This tends to prevent arcing between the roller contact 32 and the contacts 34, 36 and 38 within the recesses 40, 42 and 44 in these contacts, any arcing which does occur between the roller contact and the stationary contacts taking place outside the recesses in the stationary contacts to avoid pitting of the surfaces of the recesses.

The switch 12 includes actuating means 50 for moving the roller contact 32 along the contact path 30 and into and out of each of the recesses 40, 42 and 44 therein, the actuating means being connected to the roller contact through a spring-biased resiliently-yieldable toggle means 52 which biases the roller contact into engagement with the contact path. More particularly, the actuating means 50 includes a carrier 54 on which the toggle means 52 is mounted, the carrier having the form of a hollow cage of an electrically insulating material, such as a suitable plastic. The toggle means 52 is disposed within the carrier 54 with the roller contact 32 projecting from the carrier, and includes two levers, hereinafter referred to as toggle cranks or toggle arms 56 and 58, pivotally mounted in the carrier by spaced, parallel pivot pins 60 and 62, respectively. As best shown in Fig. 4 of the drawings, the toggle arm 58 is bifurcated to receive the toggle arm 56 therein in overlapping relation, the overlapping portions of the toggle arms 56 and 58 being provided with slots 64 and 66 therein, respectively, which extend generally radially with respect to the pivot pins 60 and 62 respectively. The roller contact 32 includes, as best shown in Fig. 4 of the drawings, two cylindrical contact elements 68 respectively engageable with the two contact elements of each of the contacts 34, 36 and 38 and connected by a freely rotatable axle 70 extending through the slots 64 and 66. The toggle arms 56 and 58 are interconnected by a tension spring 72 on the opposite sides of the respective pivot pins 60 and 62 from the respective slots 64 and 66. Thus, the tension spring 72 constantly tends to break the toggle joint or mechanism formed by the toggle arms 56 and 58 so as to bias the roller contact 32 into positive engagement with the contact path 30. As will be apparent, the slots 64 and 66 in the toggle arms 56 and 58 permit the overlapping portions of these arms to move into a plane containing the axes of the pivot pins 60 and 62 despite the fixed positions of these pins relative to the carrier 54.

The actuating means 50 also includes a toggle lever 76 which projects through the fitting 16 into the housing 14, there being a ball-and-socket connection, indicated generally by the numeral 78, between the fitting 16 and the lever 76 to provide for universal movement therebetween. While the ball-and-socket connection 78 does provide universal movement to furnish several degrees of freedom, it will be noted that movement of the carrier 54, to which the lever is connected in a manner to be described, is largely restricted to movement along the contact path 30 because of the fact that the carrier is guided along this path by the roller contact 32 mounted thereon in the manner hereinbefore described.

The lever 76 is connected to the carrier 54 by a lost-motion connection 80, which preferably provides a range of relative rocking movement between the lever and the carrier at least approaching the spacing of the contacts 34, 36 and 38 so that once movement of the roller contact 32 from one recess to the next begins, such movement is completed with little or no further movement of the lever 76 to provide a positive action which cannot be interfered with by the operator of the switch 12. Means 82 for limiting the relative rocking movement between the lever 76 and the carrier 54 is provided.

Considering the lost-motion connection 80 in more detail, mounted on the inner end of the lever 76 within the housing 14 is an actuating element or actuator 84 engaging the carrier 54 through a tongue-and-groove connection which forms the lost-motion connection 80. More specifically, in the particular construction illustrated, the actuator 84 is provided with two parallel grooves 88 and 90 therein which extend transversely of the contact path 30 and which receive complementary tongues or ribs 92 and 94, respectively, on the carrier 54. The means 82 for limiting relative motion between the actuator 84 and the carrier 54 comprises stops or kickers 96 and 98 having the form of flanges on the actuator which receive the carrier therebetween and which are engageable with opposite ends, respectively, of the carrier.

In the particular construction illustrated, the switch 12 includes a spring 100 which is engaged by the actuator 84 when the roller contact 32 is in the recess 40 and which functions to return the roller contact to the recess 42 as soon as manual pressure applied to the lever 76 is released. This return spring, which may be omitted, includes a coil 102 having at its ends radial arms 104

anchored to the block 20 at one end thereof, the coil 102 thus being circumferentially compressible and expansible about the anchor point for the ends of the arms 104. Another return spring, not shown, like the spring 100, may be employed at the opposite end of the contact path 30 if desired, although, as hereinbefore indicated, the return spring 100 may be omitted.

Turning now to a consideration of the over-all operation of the switch 12, it will be assumed initially that the return spring 100 is not present and the effect thereof will be ignored in the discussion which follows. Referring to Fig. 5 of the drawings, the various parts of the switch 12 are shown at rest with the roller contact 32 within the recess 40 in the contact element of the contact 34, the lost-motion connection 80 being at the center of the range of relative movement between the carrier 54 and the actuator 84 which is defined by the limiting means 82, i. e., the tongues 92 and 94 on the carrier are disposed in the respective grooves 88 and 90i n the actuator.

When it is desired to displace the roller contact 32 out of the recess 40 and along the contact path 30 into the recess 42, a force is applied to the outer end of the lever 76 in the direction of the arrow 106. The lost-motion connection 80 permits relative rocking movement or cocking of the actuator 84 and the carrier 54 until the kicker 96 engages the corresponding end of the carrier, the tongue 92 remaining in the groove 88 to continue to key the actuator 84 to the carrier, but the tongue 94 and the groove 90 being disengaged as the actuator cocks relative to the carrier. At the same time, the two toggle arms 56 and 58 rotate in opposite directions in opposition to the action of the tension spring 72 to permit the overlapping portions of the toggle arms to move toward, or across, an on-center position in a plane containing the axes of the pivot pins 60 and 62. The engagement of the kicker 96 with the corresponding end of the carrier 54 provides a positive driving force which causes the toggle arms 56 and 58 to rotate in opposite directions in opposition to the action of the tension spring 52 so as to enable the roller contact 32 to climb out of the recess 40, the roller contact being on the verge of leaving the recess 40 under the conditions illustrated in Fig. 6 of the drawings. Once the roller contact 32 leaves the recess 40, the energy stored in the system causes the roller contact to move along the contact path 30 into the next recess 42 with a snap action to provide a clean break between the roller contact and the contact 34 and to provide a clean make between the roller contact and the contact 36. Since, as hereinbefore mentioned, the total range of relative movement between the carrier 54 and the actuator 84 provided by the lost-motion connection 80 at least approaches the spacing of the recesses 40, 42 and 44, the roller contact 32 automatically moves to the next recess once it has been displaced out of the recess 40. Thus, once the operator applies to the lever 76 a force in the direction of the arrow 106 sufficient to displace the roller contact 32 out of the recess 40 in which it is located, no normal manual manipulation of the lever can prevent the roller contact from moving to the next recess 42. It provides a very positive and reliable action, which is an important feature.

It will be noted that the operation of the switch 12 as the roller contact 32 is moved from the recess 42 to the recess 44 is the same as hereinbefore described. For movement of the roller contact from the recess 44 to the recess 42, or from the recess 42 to the recess 40, the action is similar, but reversed.

As will be apparent, a considerable force is required to rock the actuator 84 relative to the carrier 54, through the range of relative movement permitted by the kickers 96 and 98, in order to stress the tension spring 72 sufficiently to permit the roller contact 32 to climb out of the recess in which it is disposed. Thus, the operator is provided with a positive feel advising him that the roller contact is properly positioned within one of the recesses, which is an important feature.

As hereinbefore stated, the foregoing discussion was predicated on the assumption that the return spring 100 is not present and its effect was ignored. Considering the action of this return spring, it will be noted, as shown in Fig. 5 of the drawing, that when the roller contact 32 is in the recess 40 with the lost-motion connection 80 at the center of the range of relative movement provided by the limiting means 82, one end of the actuator 84 engages the outer periphery of the circumferentially-expansible-and-compressible coil 102. Consequently, the coil 102 tends to rock the actuator 84 into the position shown in Fig. 6 of the drawings, unless a manual force is applied to the outer end of the lever 76 to maintain the parts in the positions shown in Fig. 5 of the drawings. Upon release of such manual force, the coil 102 immediately rocks the actuator 84 relative to the carrier 54 into the position shown in Fig. 6, the kicker 96 engaging the corresponding end of the carrier 54 to force the roller contact 32 out of the recess 40 and return it to the recess 42 automatically. Thus, the action provided by the return spring 100 is much like the manual action hereinbefore described, except that the operating force is applied to one end of the actuator 84, instead of being applied to the outer end of the lever 76 in the direction of the arrow 106. In all other respects, the action is much the same as hereinbefore described.

Turning now to Figs. 7 to 11 of the drawings, illustrated therein is a rotary switch 110 which embodies the present invention. Basically, the rotary switch 110 is similar to the toggle switch 12 and identical reference numerals are employed for identical parts.

The rotary switch 110 includes a housing 112 comprising a base 114, a spacer ring 116, a contact-carrying annulus 118, an outer spacer ring 120, an inner spacer ring 121, and an end disc 122, all secured together by bolts 124. The annulus 118 includes two annular plates 126 and 127 bridged by a peripheral plate 128 telescoped thereover, the inner peripheries of the annular plates 126 providing a contact path 130 for the roller contact 32. As in the toggle switch 12, the roller contact 32 is carried by the toggle means 52 on the carrier 54, the latter having the lost-motion connection 80, limited by the limiting means 82, to an actuator 84 which is virtually identical to the actuator 84 of the toggle switch 12.

The contact path 130 is provided therein with recesses 144 formed in stationary contacts 146 circumferentially spaced along the contact path. The stationary contacts 146 are shown as including separate contact elements 148 and 150 respectively set in the annular plates 126 and 127. In the particular construction illustrated, the contact elements 148 are electrically interconnected by a ring 152 which is electrically connected to a contact element 153 provided with a terminal screw 154, and the contact elements 150 are independent and are provided with individual terminal screws 156, two of the contact elements 148 being separated by the contact element 153 and being separated from the third contact element 148 by circumferentially extending spacers 157. However, the various contact elements 148 and 150 may all be independent, or they may be interconnected in various other ways. In either event, the roller contact 32 bridges the two contact elements 148 and 150 of each stationary contact 146 in the manner hereinbefore described in connection with the toggle switch 12. As best shown in Fig. 11 of the drawings, the various parts of the contact-carrying annulus 118, including the annular plates 126 and 127, the contact elements 148, 150, and 153, the contact-connecting ring 152 and the spacers 157 are all held in assembled relation by sleeves 158 adapted to receive the respective bolts 124 and having their ends peened over paired flanged bushings 160, the flange of one bushing 160 of each pair being seated against the

contact-connecting ring 152 and the flange of the other bushing 160 of such pair being seated on one of the contact elements 150 and a circumferentially extending spacer 162, Fig. 8. As shown in Fig. 11, the annular plates 126 and 127 of the contact-carrying annulus 118 are separated by tubular spacers 164, each telescoped over the bushings 160 of one of the pairs thereof.

Instead of being operated by the toggle lever 76 as in the toggle switch 12, the actuator 84 of the rotary switch 110 is operated by a drive shaft 170 rotatable about the axis of the contact-carrying annulus 118, the drive shaft, which may be equipped with a suitable knob, not shown, being rotatable in a panel-mounting fitting 172 molded into the base 114 of the housing 112 and being connected to the actuator 84 by a resiliently yieldable, lost-motion connection 174. The actuator 84, which is rotatable through 360°, is provided at its ends with end plates 176 and 178 having bearing apertures which receive stub shafts 180 and 182 on the end disc 122 and the drive shaft 170, respectively.

The end plate 178 is provided with an axially-extending arm 184 which projects between two elements 186 and 188 rotatably mounted on the drive shaft 170. A third element 190 is also rotatably mounted on the drive shaft 170 approximately diametrically opposite the elements 186 and 188, these three elements thus being pivotable relative to each other about the axis of the drive shaft. Compression springs 192 and 194 are seated against lugs 196 and 198, respectively, on the elements 186 and 188, respectively, and against lugs 200 and 202, respectively, on the element 190. Fixed on the drive shaft 170 between the assembly of elements 186, 188 and 190 and the end plate 178 on the actuator 84, is an element 204 having an arm 206 which also extends between the elements 186 and 188, along with the arm 184 of the plate 178. The foregoing structure constitutes the lost-motion connection 174 between the drive shaft 170 and the actuator 84.

It will be apparent that the over-all operation of the rotary switch 110 is very similar to that of the toggle switch 12 insofar as the common components of the two switches are concerned. In other words, the actuator 84, the lost-motion connection 80 permitting relative rocking movement between the actutaor and the carrier 54, the relative-movement-limiting means 82, the toggle means 52 on the carrier 54, the roller contact 32 on the toggle means 52, and the recesses 144 in the stationary contact 146 on the contact path 130, all cooperate in substantially the same manner as hereinbefore described in connection with the toggle switch 12.

Considering the operation of the foregoing components in connection with the operation of the lost-motion connection 174 between the actuator 84 and the drive shaft 170, rotation of the drive shaft causes the arm 206 of the element 204 fixed thereon to engage one of the elements 186 and 188, depending upon the direction of rotation, whereupon the other of the elements 186 and 188 engages the arm 184 on the end plate 178 of the actuator 84 to rotate the actuator. The arms 184 and 206 in engagement with the elements 186 and 188 tend to rotate these elements in opposite direction to stress the springs 192 and 194. When these springs have been stressed enough, the actuator 84 rocks relative to the carrier 54 sufficiently that one of the kickers 96 and 98 on the actuator engages the corresponding end of the carrier to stress the tension spring 72 of the toggle means 52 an amount such as to enable the roller contact 32 to leave the recess 144 in which it is disposed. The energy stored in the various springs in the system then causes the roller contact to snap to the next recess very rapidly. If the roller contact 32 fails to leave the recess 144 in which it is disposed for any reason, e. g., as a result of being welded to the corresponding stationary contact 146, the element 204 fixed on the drive shaft 170 eventually rotates far enough that one or the other of two lugs or kickers 208 thereon moves into engagement with the arm 184 to provide a direct connection between the drive shaft 170 and the actuator 84 independent of the springs 192 and 194. Normally, however, the roller contact 32 will snap from one recess 144 to the next before the springs 192 and 194 are stressed sufficiently to permit one of the kickers 208 to engage the arm 184.

The presence of the lost-motion connection 174 in the rotary switch 110 positively insures that the roller contact 32 will snap from one recess 144 in the contact path 130 to the next without any possibility of interference by any manual manipulation of the knob, not shown, on the drive shaft 170, which is an important feature of the invention.

Considering some additional features common to both the toggle switch 12 and the rotary switch 110, it will be noted that the roller contact 32 is physically locked in each recess because of the angular relation between the carrier 54 and the actuator 84, any increase in the cocking or rocking angle of the actuator relative to the carrier from zero or neutral tending to seat the roller contact more firmly into the recess. Also, the cocking of the carrier 54 relative to the actuator 84 as the roller contact 32 is forced out of each recess results in the development of a greater spring force in the spring 72 than would be the case if the cocking action did not exist, thereby storing additional energy in the spring and still more firmly seating the roller contact in the recess.

As the carrier 54 uncocks or straightens out relative to the actuator 84 after the roller contact 32 leaves each recess, the resulting forward movement of the carrier is added to the causative forward movement of the actuator so that the roller contact attains a very high speed in moving from one recess to the next, which is an important feature. Because of the physical locking of the roller contact 32 in each recess by the cocking action, two cooperating sources of stored energy contribute to the very high speed break in each of the switches 12 and 110. In the toggle switch 12, the energy stored in the hand muscles as the locking of the roller contact 32 in the recess is overcome is added to the energy which is stored in the spring 72 and which is released when the roller contact leaves the recess, these two sources of stored energy cooperating to produce extremely rapid movement of the roller contact from one recess to the next to minimize arcing. In the rotary switch 110, the same results are achieved, except that the energy stored in the springs 192 and 194 is substituted for that stored in the hand muscles with the switch 12.

It is important to note that in both switches the desired energy storage to produce a fast break is achieved by the angular geometry of the system only, and without the use of friction to hold the roller contact in its detented position. Consequently, all of the stored energy is utilized to advance the roller contact to the next recess, and none of it is used to overcome any friction for detenting the roller contact.

Although I have disclosed exemplary embodiments of my invention herein for purposes of illustration, it will be understood that various changes, modifications and substitutions may be incorporated in such embodiments with out departing from the spirit of the invention as hereinafter defined in the claims allowed to me.

I claim as my invention:

1. In a switch, the combination of: a contact path having spaced recesses therein and having thereon at least one stationary contact in which one of said recesses is formed; a roller contact engaging and movable along said path and receivable in each of said recesses; actuating means for moving said roller contact along said path and into and out of each of said recesses; and spring-biased toggle means connecting said roller contact and said actuating means for biasing said roller contact into engagement with said path, said toggle means being yieldable to permit movement of said roller contact out of each of

said recesses and including two toggle arms on both of which said roller contact is rotatably mounted and which are intersected by the axis of rotation of said roller contact.

2. In a switch, the combination of: an arcuate contact path having spaced recesses therein and having thereon at least one stationary contact in which one of said recesses is formed; a roller contact engaging and movable along said path and receivable in each of said recesses; actuating means for moving said roller contact along said path and into and out of each of said recesses; and spring-biased toggle means connecting said roller contact and said actuating means for biasing said roller contact into engagement with said path, said toggle means being yieldable to permit movement of said roller contact out of each of said recesses and including two toggle arms on both of which said roller contact is rotatably mounted and which are intersected by the axis of rotation of said roller contact.

3. A switch as defined in claim 2 wherein said arcuate contact path comprises part of a circle.

4. A switch as defined in claim 2 wherein said arcuate contact path comprises a full circle.

5. A switch as defined in claim 2 wherein said arcuate contact path is formed of electrically insulating material adjacent said stationary contact.

6. In a switch, the combination of: an arcuate contact path having spaced recesses therein and having thereon at least one stationary contact in which one of said recesses is formed; a roller contact engaging and movable along said path and receivable in each of said recesses; actuating means for moving said roller contact along said path and into and out of each of said recesses; and spring-biased toggle means connecting said roller contact and said actuating means for biasing said roller contact into engagement with said path, said toggle means being yieldable to permit movement of said roller contact out of each of said recesses, and said toggle means including two pivoted toggle arms on both of which said roller contact is rotatably mounted and including spring means for biasing said toggle arms in opposite directions.

7. In a switch, the combination of: an arcuate contact path having spaced recesses therein and having thereon at least one stationary contact in which one of said recesses is formed; a roller contact engaging and movable along said path and receivable in each of said recesses; actuating means, including a carrier for said roller contact, for moving said roller contact along said path and into and out of each of said recesses; and spring-biased toggle means mounted on said carrier and connected to said roller contact for biasing said roller contact into engagement with said path, said toggle means being yieldable to permit movement of said roller contact out of each of said recesses and including two toggle arms on both of which said roller contact is rotatably mounted and which are intersected by the axis of rotation of said roller contact.

8. In a switch, the combination of: an arcuate contact path having spaced recesses therein and having thereon at least one stationary contact in which one of said recesses is formed; a roller contact engaging and movable along said path and receivable in each of said recesses; actuating means, including a carrier for said roller contact, for moving said roller contact along said path and into and out of each of said recesses; and spring-biased toggle means mounted on said carrier and connected to said roller contact for biasing said roller contact into engagement with said path, said toggle means being yieldable to permit movement of said roller contact out of each of said recesses, and said toggle means including two toggle arms pivotally mounted on said carrier and spring means for biasing said toggle arms in opposite directions, said roller contact being mounted on said toggle arms.

9. In a switch, the combination of: an arcuate contact path having spaced recesses therein and having thereon at least one stationary contact in which one of said recesses is formed; a roller contact engaging and movable along said path and receivable in each of said recesses; actuating means, including a carrier for said roller contact, for moving said roller contact along said path and into and out of each of said recesses; and spring-biased toggle means mounted on said carrier and connected to said roller contact for biasing said roller contact into engagement with said path, said toggle means being yieldable to permit movement of said roller contact out of each of said recesses, and said toggle means including two toggle arms pivotally mounted on said carrier and spring means for biasing said toggle arms in opposite directions, said toggle arms having registering slots therein in which said roller contact is mounted.

10. In a switch, the combination of: an arcuate contact path having spaced recesses therein and having thereon at least one stationary contact in which one of said recesses is formed; a roller contact engaging and movable along said path and receivable in each of said recesses; actuating means for moving said roller contact along said path and into and out of each of said recesses, said actuating means including a carrier for said roller contact, an actuator, a lost-motion connection providing relative movement between said carrier and actuator, interengageable means on said actuator and said carrier for limiting said relative movement to a predetermined range, and means for centering said actuator and said carrier relative to each other in said range; and spring-biased toggle means mounted on said carrier and connected to said roller contact for biasing said roller contact into engagement with said path, said toggle means being yieldable to permit movement of said roller contact out of each of said recesses.

11. In a switch, the combination of: an arcuate contact path having spaced recesses therein and having thereon at least one stationary contact in which one of said recesses is formed; a roller contact engaging and movable along said path and receivable in each of said recesses; actuating means for moving said roller contact along said path and into and out of each of said recesses, said actuating means including a carrier for said roller contact, an actuator, a lost-motion connection providing relative rocking movement between said carrier and actuator, interengageable means on said carrier and said actuator for limiting said relative rocking movement to a predetermined range, and means for centering said actuator and said carrier relative to each other in said range; and spring-biased toggle means mounted on said carrier and connected to said roller contact for biasing said roller contact into engagement with said path, said toggle means being yieldable to permit movement of said roller contact out of said recesses, and said toggle means including two toggle arms pivotally mounted on said carrier and spring means connected to said toggle arms for biasing them in opposite directions, said roller contact being rotatably mounted on both of said toggle arms.

12. In a switch, the combination of: an arcuate contact path having spaced recesses therein and having thereon at least one stationary contact in which one of said recesses is formed; a roller contact engaging and movable along said path and receivable in each of said recesses; actuating means for moving said roller contact along said path and into and out of each of said recesses, said actuating means including a carrier for said roller contact, an actuator, a lost-motion connection providing relative rocking movement between said carrier and actuator, and means for limiting said relative rocking movement; and spring-biased toggle means mounted on said carrier and connected to said roller contact for biasing said roller contact into engagement with said path, said toggle means being yieldable to permit movement of said roller contact out of each of said recesses, and said toggle means including two toggle arms pivotally mounted on said carrier and spring means connected to said toggle arms for biasing

them in opposite directions, said toggle arms being provided with registering slots in which said roller contact is mounted.

13. In a switch, the combination of: a contact carrier; a contact; and spring-biased toggle means mounted on said carrier and connected to said contact, said toggle means including two toggle arms pivotally mounted on said carrier and being connected to said contact, and including spring means for biasing said toggle arms in opposite directions.

14. In a switch, the combination of: a contact carrier; a contact; and spring-biased toggle means mounted on said carrier and connected to said contact, said toggle means including two toggle arms pivotally mounted on said carrier and spring means for biasing said toggle arms in opposite directions, said toggle arms being provided with registering slots in which said contact is mounted.

15. In a switch, the combination of: a contact path having a recess therein; a roller contact engaging and movable along said path and receivable in said recess; an actuator; means for connecting said roller contact to said actuator, including spring-biased toggle means for biasing said roller contact into engagement with said path; a drive shaft; and a resiliently yieldable, lost-motion connection between said drive shaft and said actuator.

16. A switch according to claim 15 wherein said resiliently yieldable, lost-motion connection includes: three free elements rotatable on said shaft; two springs both connected to one of said free elements and respectively connected to the other two free elements; means fixed on said shaft and engageable with one or the other of said other two free elements; and means on said actuator and engageable with one or the other of said other two free elements.

17. A switch including: a contact carrier; a roller contact carried by said carrier; an actuator; a lost-motion connection between said actuator and said carrier and having means providing relative rocking movement between said actuator and said carrier; interengageable means on said actuator and said carrier for limiting said relative rocking movement to a predetermined range; and means for biasing said actuator and said carrier relative to each other toward the center of said range.

18. A switch as defined in claim 17 including a contact path having a recess therein, said roller contact engaging and being movable along said contact path and being receivable in said recess, said biasing means including spring means operatively connected to said roller contact for biasing said roller contact into engagement with said contact path.

19. A switch as defined in claim 17 wherein said carrier is seatable against said actuator and is provided with two spaced, parallel portions each engageable with said actuator, said carrier being pivotable relative to said actuator about each of said portions to provide said relative rocking movement between said actuator and said carrier.

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U. S. DEPARTMENT OF COMMERCE

PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,831,073 Howard F. Mason April 15, 1958

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 5, line 19, for "90i n" read -- 90 in --; column 11, line 8, for "being" read -- both --.

Signed and sealed this 3rd day of June 1958.

(SEAL)

Attest:

KARL H. AXLINE

Attesting Officer

ROBERT C. WATSON

Commissioner of Patents

U. S. DEPARTMENT OF COMMERCE

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